Application Engineering Data

Basic Torque Formula:

$$T = \frac{hp \times 5{,}252}{N_{cb}} \times SF$$

Where:

- T = Average dynamic torque, lb-ft
- hp = Motor horsepower
- SF = Service factor
- N_{cb} = rpm of the clutch/brake shaft
- 5,252 = Constant

Inertia:

$$I = W \times K^2$$

Where:

- W = Weight of the object
- K^2 = The square of the radius of gyration

Velocity, Linear:

$$V = \pi DN$$

Where:

- π = 3.142
- D = Diameter of drive head pulley
- N = rpm

Reflected Inertia - Linear:

$$Wk_L^2 = W\left(\frac{V}{2\pi N_{cb}}\right)^2$$

Where

- W = The weight of the component, lb
- V = The velocity of the component in feet per minute
- N_{cb} = The rpm of the clutch/brake shaft

Reflected Inertia - Rotational:

$$Wk_r^2 = Wk_C^2 \times \left(\frac{N}{N_{cb}}\right)^2$$

Where:

- Wk_r^2 = Inertia reflected to the clutch or brake
- Wk_C^2 = Inertia of the component
- N = rpm of the component
- N_{cb} = rpm of the clutch or brake shaft

Dynamic Torque:

$$T_d = \frac{Wk^2 \times N}{308 \times t}$$

Where:

- T_d = Dynamic torque, lb-ft
- Wk^2 = Total inertia seen by the clutch/brake (including the clutch/brake inertia and motor inertia if applicable), lb-ft^2
- N = rpm of the clutch/brake
- t = Stopping time in seconds (or starting time)
- 308 = Constant

Thermal Capacity:

$$E = 1.7 \times WR^2 \left(\frac{N}{100}\right)^2 \times F$$

Where:

- E = Energy (heat) which needs to be dissipated, (ft-lb/min) for the application requirement
- WR^2 = Total reflected inertia at clutch/brake shaft location. This should include clutch/brake inertia. (lb-ft^2)
- N = Speed differential in revolutions per minute (rpm) at the clutch/brake shaft.
- F = Number of cycles per minute (cycle rate).

Ohms Law:

Ohms = Volts/Amperes

$$\left(R = \frac{E}{I}\right)$$

Amperes = Volts/Ohms

$$\left(I = \frac{E}{R}\right)$$

Volts = Amperes × Ohms

(E = IR)

Power - DC Circuits:

Watts = Volts × Amperes

(W = EI)

$$\text{Amperes} = \frac{\text{Watts}}{\text{Volts}} \quad \left(I = \frac{W}{E}\right)$$

Inertia Table

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Wk² of Steel Shafting or Disc per Inch of Length

Dia. (inch)	Wk² (lb-ft²)	Dia. (inch)	Wk² (lb-ft²)	Dia. (inch)	Wk² (lb-ft²)	Dia. (inch)	Wk² (lb-ft²)	Dia. (inch)	Wk² (lb-ft²)
1/8	4.53×10^{-8}	4	.0491	9 3/4	1.735	25	75.00	48	1019.2
1/4	7.47×10^{-7}	4 1/4	.0626	10	1.920	26	87.74	49	1106.8
3/8	3.83×10^{-6}	4 1/2	.0787	10 1/2	2.334	27	102.0	50	1200.0
1/2	1.21×10^{-5}	4 3/4	.0977	11	2.811	28	118.0	51	1298.9
5/8	2.93×10^{-5}	5	.1200	11 1/2	3.358	29	135.8	52	1403.8
3/4	6.07×10^{-5}	5 1/4	.1458	12	3.981	30	155.5	53	1514.9
7/8	.0001	5 1/2	.1757	12 1/2	4.687	31	177.3	54	1632.5
1	.0002	5 3/4	.2099	13	5.484	32	201.3	55	1756.9
1 1/8	.0003	6	.2488	13 1/2	6.377	33	227.7	56	1888.2
1 1/4	.0005	6 1/4	.2930	14	7.376	34	256.6	57	2026.7
1 3/8	.0007	6 1/2	.3427	14 1/2	8.487	35	288.1	58	2172.7
1 1/2	.0010	6 3/4	.3986	15	9.720	36	322.5	59	2326.5
1 5/8	.0013	7	.4610	15 1/2	11.08	37	359.8	60	2488.3
1 3/4	.0018	7 1/4	.5304	16	12.58	38	400.3	66	3643.1
1 7/8	.0024	7 1/2	.6075	16 1/2	14.23	39	444.2	72	5159.6
2	.0031	7 3/4	.6926	17	16.04	40	491.5	78	7166.7
2 1/4	.005	8	.7864	18	20.15	41	542.5	84	9558.9
2 1/2	.0075	8 1/4	.8894	19	25.02	42	597.4	90	12597
2 3/4	.0110	8 1/2	1.002	20	30.72	43	656.4	96	16307
3	.0156	8 3/4	1.125	21	37.34	44	719.6	102	20782
3 1/4	.0214	9	1.260	22	44.98	45	787.3		
3 1/2	.0288	9 1/4	1.405	23	53.73	46	859.6		
3 3/4	.0380	9 1/2	1.564	24	63.70	47	936.9		

To determine Wk² of a given shaft length or disc shape thickness, multiply the table value given above by the length, or thickness, in inches.

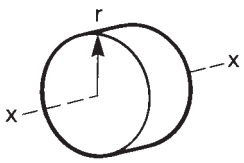
Material Factors

Multiply the inertia of the steel diameter by the selected material.

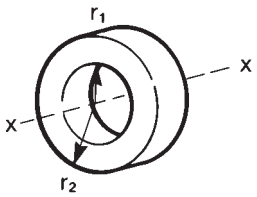
Bronze 1.1	Nylon .18
Aluminum .35	Cast iron .92

Radius of Gyration, Squared

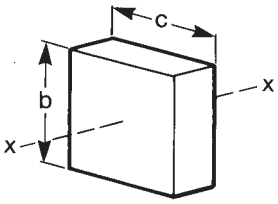
Cylinder about Its Own Axis x-x



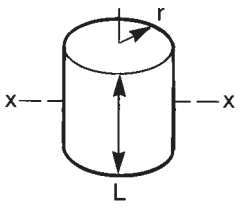
Solid	Hollow
$K^2 = \frac{1}{2}r^2$	$K^2 = \frac{1}{2}(r_1^2 + r_2^2)$



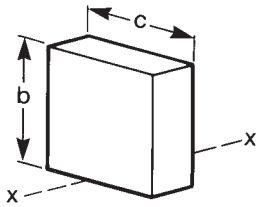
Axis through Center x-x



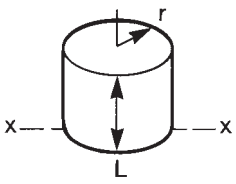
Prism	Cylinder
$K^2 = \frac{1}{12}(b^2 + c^2)$	$K^2 = \frac{L^2 + 3r^2}{12}$



Axis at One End x-x



Prism	Cylinder
$K^2 = \frac{1}{12}(4b^2 + c^2)$	$K^2 = \frac{4L^2 + 3r^2}{12}$



English-Metric Conversion Factors

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Multiply the base unit by the factor shown to obtain the desired conversion

Measurement	Base Unit	Factor	Conversion
Length	inch, in *millimeter, mm*	25.4 .03937	*millimeter, mm* inch, in
Torque	pound-inch, lb-in *newton-meter, Nm* pound-feet, lb-ft *newton-meter, Nm* ounce-inch, oz-in *newton-meter, Nm*	.112985 8.8507 1.355818 .73756 .007062 141.612	*newton-meter, Nm* pound-inch, lb-in *newton-meter, Nm* pound-feet, lb-ft *newton-meter, Nm* ounce-inch, oz-in
Moment of Inertia	pound-feet squared, lb-ft^2 *kilogram-meter squared, kgm^2*	.042 23.81	*kilogram-meter squared, kgm^2* pound-feet squared, lb-ft^2
Kinetic energy	foot-pound, ft-lb *joule, J*	1.355818 .73756	*joule, J* foot-pound, ft-lb
Weight	pound, lb *kilogram, kg*	.453592 2.20462	*kilogram, kg* pound, lb
Horsepower (English)	horsepower, hp *kilowatt, Kw*	.7457 1.341	*kilowatt, kW* horsepower, hp
Thermal capacity	horsepower-seconds per minute, hp-sec/min	12.42833	*watts, W*
	watts, W	.08046	horsepower-seconds per minute hp-sec/min
Temperature	degrees Fahrenheit, °F *degrees Celcius, °C*	(°F - 32) · 5/9 (°C · 9/5) + 32	*degrees Celcius, °C* degrees Fahrenheit, °F

Conversion Factors for Thermal Capacity

Base Unit	Multiply by	To Obtain
horsepower	33,000	ft-lb/min
hp-sec/min	550	ft-lb/min
BTU/min	777.385	ft-lb/min
watts	44.254	ft-lb/min

Metric Bore and Keyways

Bore (millimeter) + .25 mm - .000 mm	Keyway (millimeter) Nominal
6	2 x 2
8	2 x 2
10	3 x 3
12	4 x 4
14	5 x 5
15	5 x 5
16	5 x 5
18	6 x 6
19	6 x 6
20	6 x 6
22	6 x 6
24	8 x 7
25	8 x 7
26	8 x 7
28	8 x 7
30	8 x 7

Contact factory for specific application information